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MINERAL INFORMATION SERVICE

Vol. 11 May 1, 1958 No. 5

MINERAL INFORMATION SERVICE is designed to inform the public on the geology and mineral resources of California and on the usefulness of minerals and rocks, and to serve as a news release on mineral discoveries, mining operations, markets, statistics, and new publications. It is issued monthly by the California State Division of Mines. Subscription price, January through December, is $1.00.

SULFUR AND PYRITES

California's numerous sulfur-consuming industries offer a vast market for sulfur and for materials from which sulfur can be economically extracted. California sulfur production, which amounts to more than 250,000 tons annually, cannot begin to supply the state's needs, but there is a constant incentive toward increasing the output of in-state sources. Roughly one fifth of the California production comes from deposits of native sulfur of volcanic origin; the remainder is recovered as a co-product in the processing of oil and gas. In addition to production of elemental sulfur, deposits of iron pyrites yield an additional 65,000 tons of sulfur annually, but this is converted directly into sulfuric acid during processing.

The important national developments in sulfur and pyrites since 1955 were (1) The impact of the first substantial commercial production from the new Frasch-process mines in Mexico. (2) The increased domestic production accompanied by a decline in the price of crude sulfur. (3) The increased production of Canadian pyrites and byproduct sulfur. (4) A substantial increase in the number and capacity of byproduct-sulfur recovery units in the United States.

In California, the developments in sulfur mining and processing since 1955 included: (1) The conversion of the Iron Mountain pyrite mine to an open pit operation. (2) Increased production by the Anaconda Company at the Leviathan sulfur mine in Alpine County. (3) The continued sporadic exploitation of sulfur deposits in the Last Chance Range of Inyo County. (4) The completion of several new sulfur recovery units and expansion of several others. (5) Renewed activity at the Sulphur Bank mine in Lake County and at the Maricopa sulfur-gypsum deposits in Kern County.

MINERALOGY AND GEOLOGY

Sulfur normally occurs as well-developed bipyramidal or tabular orthorhombic crystals, and as earthy or disseminated masses. It has a resinous luster, yellow or gray color, hardness of 1.5 to 2.5, and a density of 2.05.

Pyrites is a general name applied to a group of iron sulfide minerals that includes pyrite, marcasite, and pyrrhotite. These minerals have a metallic luster and a brass- or bronze-yellow color. Pyrite and marcasite have a hardness of 6 to 6.5, a density ranging from 4.85 to 5.10, and a brownish-black streak (pyrite streak may be greenish-black). Pyrrhotite is distinguished by lower hardness (3.5 to 4.5) and density (4.58 to 4.64),a dark-gray or black streak, and weak to moderate magnetism. Pyrite occurs in cubes, pyritohedrons, and massive veins and lenses; marcasite commonly is massive,but may exhibit "coxcomb" structure; distinct crystals of pyrrhotite are rare.

Native sulfur occurs in salt-dome caprock, as sedimentary beds, and as deposits associated with volcanism. Most of the sulfur consumed in the U.S. is obtained from the Gulf Coast of Texas and Louisiana, where salt domes of various sizes have intruded great thicknesses of sedimentary rocks. Many of these domes are capped by limestone, sulfur, anhydrite, and gypsum. The sulfur commonly occurs as a replacement of the limestone. Most of the zones of sulfur-bearing limestone are between 25 and 300 feet thick,and cover salt domes 100 to 2000 acres in extent. The newly developed sulfur deposits in Mexico occur in a similar geological environment. Millions of tons of sulfur are produced annually from these deposits by means of the Frasch process, in which superheated water is injected into the deposit through part of a bore hole while melted sulfur is pumped to the surface through another part.

Most sulfur of volcanic origin occurs as disseminations, massive replacement bodies, or veins. Disseminated sulfur is characteristic of deposits in which the ore grade is less than 50 percent, although such disseminations commonly form envelopes about richer massive replacement bodies. Large veins usually are found in the lower parts of deposits where the wall-rock is relatively unaltered. Sulfur formed by hot-spring action may be deposited in sediments at the bottoms of warm lakes. Sulfur also forms as liquid flows from volcanic vents, as cement in near-surface alluvium, and as sublimates about sulfurous gas vents. Sulfur deposits of volcanic origin account for only 3 percent of the total annual world production of sulfur. Japan is the foremost producer of this type of sulfur. Production of volcanic sulfur in the United States has come from California, Colorado, Idaho, Nevada,Utah, and Wyoming.

Pyrite is a widespread accessory mineral in almost all types of rock. It is most common as a gangue mineral in metallic ore deposits, but these are rarely mined for their pyrite. Only massive bodies of pyrite are suitable for mining for their sulfur content. Marcasite occurs under many of the